

REMARKS

Claims 1-10 were examined and reported in the Office Action. Claims 1-10 are rejected. Claim 9 is cancelled. Claims 1-3 and 8 are amended. Claims 1-10 remain. . Claims 1-3 and 8 are amended to particularly point out and distinctly claim the subject matter without the addition of new matter.

Applicant requests reconsideration of the application in view of the following remarks.

I. 35 U.S.C. §103(a)

A. It is asserted in the Office Action that claims 8-10 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,439,553 issued to Grant et al ("Grant") in view of U. S. Patent No. 6,238,580 issued to Cole et al ("Cole"). Applicant respectfully disagrees.

According to MPEP 2142 "[t]o establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." (In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)). Further, according to MPEP 2143.03, "[t]o establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. (In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974)." "*All words in a claim must be considered in judging the patentability of that claim against the prior art.*" (In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970), emphasis added).

Applicant's amended claim 8 contains the limitations of "[a] method for removing silicon oxide of a sacrificial layer for a microstructure in a MEMS device, comprising: removing the silicon oxide of a sacrificial layer by performing a vapor etching using anhydrous HF and alcohol by controlling a temperature and a pressure inside of an etching chamber to be within the region of a vapor of a phase equilibrium diagram of water, wherein the vapor etching is performed under a total pressure of an etching chamber ranged from about 25 torr to about 75 torr and a temperature of a substrate ranged from about 25°C to about 75°C, and a temperature inside of the etching chamber is maintained to be higher than that of the substrate so as to discharge the water generated during the vapor etching without condensation."

Applicant's claimed invention discloses a method for releasing a microstructure when fabricating a MEMS device having a long microstructure, e.g., 1200 μ m cantilever (see, Applicant's Figure 6). According to amended claim 8, the vapor etching is performed under a total pressure of an etching chamber ranged from about 25 torr to about 75 torr, the temperature of the substrate is ranged from about 25°C to about 75°C, and the temperature inside of the etching chamber is maintained to be higher than that of the substrate so as to discharge the water generated during the vapor etching without any condensation.

Cole discloses a wet and vapor acid etching method that releases a MEMS structure from a substrate by dissolving a sacrificial layer disposed between the MEMS and the substrate. The sacrificial layer may be a silicon dioxide (SiO_2) layer having a field portion over which the MEMS does not extend and a support portion over which the MEMS does extend. The field portion of the SiO_2 layer is quickly removed using conventional wet hydrofluoric (HF) etching followed by rinsing and drying and then the support portion is removed using conventional vapor HF etching from a solution greater than 45% by weight percent. The wet HF chemical etch quickly removes the large field portion of the sacrificial layer. The HF vapor etch removes the small support portion of the sacrificial layer below the MEMS to release the MEMS from the substrate without stiction thereby preventing damage to the MEMS when released.

Cole also discloses in the HF vapor etch of the silicon dioxide sacrificial layer, condensation of water on the etching surface renders the vapor process not so dry and the results have not been so satisfactory (Cole, column 1, lines 42-45 and 64-67; column 2, lines 1-11). Condensation cannot be avoided easily since water molecules are produced on the surface as a result of the chemical reaction for oxide etching. The problem of removing water from the HF vapor has been solved by providing an anhydrous HF and CH₃OH vapor mixture to release the MEMS structure in a completely dry fashion without stiction. This system disadvantageously requires the use of more complicated equipment, such as an exhaust system. Therefore, in Cole, the sacrificial layer may be a silicon dioxide (SiO₂) layer having a field portion over which the MEMS does not extend and a support portion over which the MEMS does extend.

Grant discloses a method of etching oxides on a surface of a substrate. The method disclosed by Grant includes etching with a gas phase mixture of a halide-containing species, an organic material having a higher vapor pressure than water at standard conditions of room temperature and pressure of 1 atmosphere, and water, in an enclosed chamber at a pressure such that water is substantially maintained in the gas phase and condensation of species present on the etched surface is minimized.

Distinguishable, the method (i.e., the HF vapor etch method) disclosed by Grant can not be used for releasing a microstructure for fabricating a MEMS device having a long microstructure in view of the reason as mentioned above. Further, the meaning of the vapor pressure used in Grant is apparently different from that of the total pressure used in Applicant's claimed invention (See Appendix A attached herewith). Accordingly, the total pressure of 25-75 torr in Applicant's claimed invention cannot be compared with the vapor pressure of 1-100 torr in Grant. In other words, Grant teaches HF, methanol and water become vapor phase when the temperature is over 65°C. In Applicant's claimed invention, however, to release a microstructure without stiction, the vapor etching is performed under the condition where a total pressure of an etching chamber ranged from about 25 torr to about 75 torr and a temperature of a substrate ranged from about 25°C to about 75°C. When the total pressure ranges about 25 torr to about 75 torr, if the room temperature is over 20°C, all species, i.e., HF,

methanol and water are in vapor phase, and therefore, the microstructure can be released without stiction.

Therefore, even if Grant is combined with Cole, the resulting invention would still not arrive with Applicant's claimed invention because neither Grant, Cole, nor the combination of the two, teach, disclose or suggest all the limitations of Applicant's amended claim 8. Since Grant, Cole, or the combination of the two, do not disclose, teach or suggest all the limitations contained in Applicant's amended claim 8, as listed above, there would not be any motivation to arrive at Applicant's claimed invention. Thus, Applicant's amended claim 8 is not obvious over Grant in view of Cole since a *prima facie* case of obviousness has not been met under MPEP 2142. Additionally, the claim that directly depends from Applicant's amended claim 8, namely claim 10, is also not obvious over Grant in view of Cole for the above same reason.

Accordingly, withdrawal of the 35 U.S.C. §103(a) rejection for claims 8 and 10 (claim 9 being cancelled) is respectfully requested.

B. It is asserted in the Office Action that claims 1-7 are rejected under 35 U.S.C. §103(a) as being unpatentable over Grant in view of U. S. Patent No. 6,126,734 issued to Bergman et al and further in view of Cole. Applicant respectfully disagrees.

Applicant's amended claim 1 contains the limitations of "[a] method for releasing a microstructure for fabricating a device of a micro electro mechanical system (MEMS), comprising: supplying bubbled alcohol vapor as a catalyst with anhydrous HF; maintaining a temperature of the supplying device and a moving path of the anhydrous HF and the alcohol to be higher than a boiling point of the alcohol; performing a vapor etching by controlling a temperature and a pressure to be within the vapor region of a phase equilibrium diagram of water, thereby removing silicon oxide of a sacrificial layer on a lower portion of the microstructure, wherein the vapor etching is performed under a total pressure of an etching chamber ranged from about 25 torr to about 75 torr and a temperature of a substrate ranged from about 25°C to about 75°C, and a temperature inside of the etching chamber is maintained to be higher

than that of the substrate so as to discharge the water generated during the vapor etching without condensation."

Applicant's claimed invention discloses a method for releasing a microstructure when fabricating a MEMS device having a long microstructure, e.g., 1200 μ m cantilever (see, Applicant's Figure 6). According to amended claim 8, the vapor etching is performed under a total pressure of an etching chamber ranged from about 25 torr to about 75 torr, the temperature of the substrate is ranged from about 25°C to about 75°C, and the temperature inside of the etching chamber is maintained to be higher than that of the substrate so as to discharge the water generated during the vapor etching without any condensation.

Bergman discloses a method using vapor phase processing streams made from a liquid phase source and feed gas. Bergman, however, does not teach, disclose or suggest the absence of condensation of water vapor on the substrate during a slow gas-solid reaction nor prevention of stiction generated by a surface tension due to the residue during or after etching.

As discussed above in section I (A), in Cole condensation cannot be avoided easily since water molecules are produced on the surface as a result of the chemical reaction for oxide etching. The problem of removing water from the HF vapor has been solved by providing an anhydrous HF and CH₃OH vapor mixture to release the MEMS structure in a completely dry fashion without stiction. This system disadvantageously requires the use of more complicated equipment, such as an exhaust system. Therefore, in Cole, the sacrificial layer may be a silicon dioxide (SiO₂) layer having a field portion over which the MEMS does not extend and a support portion over which the MEMS does extend.

Also as discussed above, the method disclosed in Grant is distinguishable from Applicant's claimed invention as Grant's method can not be used for releasing a microstructure for fabricating a MEMS device having a long microstructure. Further, the meaning of the vapor pressure used in Grant is apparently different from that of the total pressure used in Applicant's claimed invention (See Appendix A attached

herewith). Accordingly, the total pressure of 25-75 torr in Applicant's claimed invention cannot be compared with the vapor pressure of 1-100 torr in Grant. In other words, Grant teaches HF, methanol and water become vapor phase when the temperature is over 65°C. In Applicant's claimed invention, however, to release a microstructure without stiction, the vapor etching is performed under the condition where a total pressure of an etching chamber ranged from about 25 torr to about 75 torr and a temperature of a substrate ranged from about 25°C to about 75°C. When the total pressure ranges about 25 torr to about 75 torr, if the room temperature is over 20°C, all species, i.e., HF, methanol and water are in vapor phase, and therefore, the microstructure can be released without stiction.

Therefore, even if Grant and Cole is combined with Bergman, the resulting invention would still not arrive with Applicant's claimed invention because neither Grant, Cole, Bergman, nor the combination of the three, teach, disclose or suggest all the limitations of Applicant's amended claim 1. Since Grant, Cole, Bergman or the combination of the three, do not disclose, teach or suggest all the limitations contained in Applicant's amended claim 1, as listed above, there would not be any motivation to arrive at Applicant's claimed invention. Thus, Applicant's amended claim 1 is not obvious over Grant and Cole in view of Bergman since a *prima facie* case of obviousness has not been met under MPEP 2142. Additionally, the claims that directly or indirectly depend from Applicant's amended claim 1, namely claims 2-7, are also not obvious over Grant and Cole in view of Bergman for the above same reason.

Accordingly, withdrawal of the 35 U.S.C. §103(a) rejection for claims 1-7 is respectfully requested.

CONCLUSION

In view of the foregoing, it is submitted that claims 1-8, and 10 patentably define the subject invention over the cited references of record, and are in condition for allowance and such action is earnestly solicited at the earliest possible date. If the Examiner believes a telephone conference would be useful in moving the case forward, he is encouraged to contact the undersigned at (310) 207-3800.

If necessary, the Commissioner is hereby authorized in this, concurrent and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2666 for any additional fees required under 37 C.F.R. §§1.16 or 1.17, particularly, extension of time fees.

PETITION FOR EXTENSION OF TIME

Per 37 C.F.R. 1.136(a) and in connection with the Office Action mailed on THURSDAY, JUNE 5, 2003, Applicant respectfully petitions Commissioner for a three (3) month extension of time, extending the period for response to FRIDAY, DECEMBER 5, 2003. The Commissioner is hereby authorized to charge payment to Deposit Account No. 02-2666 in the amount of \$475.00 to cover the petition filing fee for a 37 C.F.R. 1.17(a)(3) small entity. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: December 5, 2003 _____

Steven Laut, Reg. No. 47,736

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025
(310) 207-3800

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to: Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450 on December 5, 2003.

Jean Svoboda

<Appendix A>

Definition of vapor pressure;

The pressure exerted by a vapor in equilibrium with the solid or liquid phase of the same substance. Saturated vapor pressure is the vapor pressure which is in equilibrium with an open liquid surface. Therefore, it is also the pressure at which a liquid will vaporize for a given temperature. If the pressure to which the liquid is exposed is equal to the saturated vapor pressure for a given temperature, then the water will "boil".

The amount of pressure which is exerted by the vapor phase of a liquid that has undergone some evaporation. When the rate of evaporation of the liquid into the vapor phase and the rate of condensation of the vapor back into the liquid phase are equal, the amount of pressure is called the "equilibrium vapor pressure."

Partial pressure of an individual gas in a mixture of gases;

The partial pressure exerted by an individual gas in a mixture of gases. For a mixture of gases in any container, the total pressure exerted is the sum of the pressures that each gas would exert if it were alone.

This Dalton's law of partial pressures can be expressed in equation form as:

$$p = p_1 + p_2 + p_3 + \dots$$

where p is the total or measured pressure and $p_1, p_2, p_3\dots$ are the partial pressures of the individual gases.

In our cases, an appropriate form of Dalton's law would be:

$$p(\text{chamber pressure}) = p(\text{HF}) + p(M) + p(\text{nitrogen}) \quad (M=\text{alcoholic vapor})$$

When the total pressure of chamber pressure is 50 torr, the partial pressures of each of its components (in torr) are numerically equal to the mole per cent of that component. Thus the partial pressures of gas mixtures at 50 torr are anhydrous hydrogen fluoride (HF), 23.15 torr, alcoholic vapor such as methanol, 3.70 torr and other is the partial pressure of the nitrogen gas.